SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

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THE BRITISH ASSOCIATION AT SOUTHPORT.

THE meeting at Southport was not merely a great success as regards the numbers attending it, but in that of the influential members present. As regards Meteorology, the following list shows that the attendance was exceptionally good :—

Adams, Prof., J.C., F.R.S.	Cambridge.
Barrington, R. M.	Fassaroe, Wicklow.
Bateman, J. F., C.E., F.R.S.	Westminster.
Black, W. J., F.M.S.	Edinburgh.
Capper, R.	Swansea.
Capron, J. R., F.M.S.	Guildford.
Chadburn, A.	Sheffield.
Chambers, C., F.R.S.	Bombay.
Chambers, C., jun.	Bombay.
Chapman, T. A.	Hereford.
Copeland, R., Ph.D.	Dunecht.
Crewdson, Rev. G.	Kendal.
Crowley, F., F.M.S.	Alton.
Edge, T. L. K., F.M.S.	Strelley Hall, Nottingham.
Edmonds, F. B., F.M.S.	London.
Evans, J., D.C.L., Treas. R.S., F.M.S.	Hemel Hempsted.
Fordham, H. G.	Royston.
Fox, C.	Kingsbridge.
Galton, Capt., C.B., F.R.S., F.M.S.	London.
Galton, Francis, F.R.S.	London.
Glaisher, J., F.R.S., F.M.S.	Greenwich.
Healey, G.	Windermere.
Hughes, G. P.	Wooler.
Latham, Baldwin, C.E., F.M.S.	London.
Laughton, J. K., Pres. M.S.	Greenwich.
Lowe, E. J., F.R.S., F.M.S.	Chepstow.
Mackeson, H. B., F.M.S.	Hythe.
Maclear, Capt., R.N., F.M.S.	Cranleigh.
Mellish, H., F.M.S.	Hodsock Priory, Worksop.
Muirhead, H., M.D.	Cambuslang.
Nelson, R. J.	Kendal.
Pengelly, W., F.R.S.	Lamorna, Torquay.
Perry, Rev. S. J., F.R.S., F.M.S.	Stonyhurst.
Roberts, Isaac	Liverpool.
Scott, Prof. A. W.	Lampeter.
Shaw, H. S. Hele, F.M.S.	Clifton.
Sidebotham, J. W.	Erlesdene, Bowden.

Siemens, Sir W., F.R.S., F.M.S. ...	London.
Smelt, Rev. M. A., F.M.S.	Cheltenham.
Smith, B. Woodd, F.M.S.....	Hampstead.
Southall, J. S.	Ross.
Stanley, W. F., F.M.S.	South Norwood.
Stewart, Prof. Balfour, F.R.S., F.M.S.	Manchester.
Symons, G. J., F.R.S., Sec. M.S.....	London.
Taylor, T.....	Aston Rowant, Tetsworth.
Twamley, C..... ..	Coventry.
Verney, Capt., R.N., F.M.S.	Bangor.
Ward, T.	Blackpool.
Wilson, T., F.M.S.....	Harpenden.

Among the papers read were the following :—

Report of the Committee on Underground Temperature.

Report of the Committee on the Underground Waters of England and Wales.

Report of the Committee on Meteoric Dust.

Report of the Committee appointed to co-operate with the Scottish Meteorological Society, in making Meteorological Observations on Ben Nevis.

SIR J. E. ALEXANDER.—*The Evils arising from the Pollution of Rivers.*

W. G. BLACK.—*Description of a Marine Anemometer.*

J. RAND CAPRON.—*On some points in Lemström's recent Auroral Experiments in Lapland.*

BALDWIN LATHAM.—*The Influence of Barometric Pressure on the Discharge of Water from Springs.*

PROFESSOR LÜROTH.—*On Measuring the Height of Clouds.*

I. ROBERTS.—*On the Attractive Influence of the Sun and Moon in causing Tides, and the variations in atmospheric pressure and rainfall, causing oscillations in underground waters in porous strata.*

PROFESSORS ROSCOE AND BALFOUR STEWART.—*On the Heat of Sunshine at Kew Observatory, as registered by Campbell's method.*

PROFESSOR BALFOUR STEWART AND W. LANT CARPENTER.—*On apparent Sun Spot Inequalities of short period.*

G. J. SYMONS.—*On the Completion of the European portion of the Preliminary Meteorological Catalogue.*

UNDERGROUND WATER.

Ninth Report of the Committee for investigating the Circulation of Underground Waters in the Permeable Formations of England, and the Quantity and Character of the Water supplied to various Towns and Districts from these Formations. Report drawn up by C. E. DE RANCE.

Ten years having elapsed since the Committee was appointed at Belfast, they think this a fitting opportunity to review the results already obtained, and to point out what additional information they consider to be still required, in the hope that they may receive assistance in their investigations from the various local societies or from individuals who may be disposed to aid in the work. The work intrusted to the Committee was twofold—first, to inquire into the circulation of underground waters in permeable formations ; secondly, to ascertain the quantity and quality of the water supplied to towns and districts from these formations. The information obtained occupies nine reports ; the eight already published fill up no less than 163 pages of the annual volumes of the Association, and contain a record of upwards of 500 wells and borings. The

Committee believe that the publication of these results, by directing public opinion to the value of such supplies, and by the preservation of the records of those carried out, has given an impetus to water of this class being generally adopted for domestic consumption in districts where gravitation supplies are unsuitable or unattainable. As regards the first head of inquiry—the circulation of underground water—much remains to be learnt, especially as to the influence of variation of barometrical pressure on the volume of springs. Independent investigation is now being carried on by Mr. Baldwin Latham, but it is exceedingly desirable that numerous observations should be taken in different classes of rocks, the quantity of water a rock is capable of holding, being no measure of the quantity of water it is capable of yielding. The difference of the period of time in which two rocks will absorb, and give off by gravity, the same quantity of water is governed by the difference of their chemical composition. The chemical composition of two rocks being identical, their facility of discharge of water is in direct relation to the amount by which they are traversed by planes of joints and fissures, and the extent these may run parallel or at right angles to the valleys which cut into and expose the water-bearing beds. The proportion of the annual rainfall that is absorbed by different classes of rocks is a subject that requires further examination. The quantity is largely regulated by the quantity stored from previous years. After a succession of dry years the permanent water-level is reduced to a minimum, the water gradient becomes nearly flat and the springs cease to flow. The first heavy rains will be nearly wholly absorbed, until the maximum water-gradient is reached and the rocks are stored with the largest amount of water they can hold. After they are once charged, all excess of rainfall runs off in floods, and the amount absorbed is practically *nil*. Spread over the twelve months, the annual amount absorbed is probably never more than 15 in., and the average ranges from 5 in. in chalk countries, to 10 in. in new red sandstone areas. In millstone grit districts about 8 in. are absorbed, but the permeable beds are thin, and the water is thrown off again in numerous springs, as a rule in the same drainage basin, giving permanence to the dry-weather flow of the streams traversing them. Except in *waterworks drainage areas* few observations exist as to the actual volumes run off daily by the rivers of this country, and data on this subject are much required, as well as a permanent record of the height to which floods rise in the various river basins. Further observations are required as to the action of faults in acting as ducts, along the face of which water is constantly passing, and barriers separating districts into distinct drainage areas. The facts hitherto obtained point to faults traversing thick permeable sandstone and limestone, having these formations on both sides of the dislocation, as offering no obstacle to the free passage of waters, which, even if locally obstructed by the hardened face or slickenside jointing of the fault, invariably finds its way through cracks extending across the width of the fault, while in faults traversing shales and clays of any age, the fissure, be it wide or narrow, always appears to have been filled with the impermeable material forming the sides, and in some cases, when porous rocks have been immediately overlaid by impermeable material since denuded, the fissure of the fault has been filled from above at a time when the fault had an upward prolongation, destroyed with the denuded material referred to. The daily registration of the heights of the streams might easily be made on gauges, painted on the county bridges, but the organization necessary to carry this out is entirely beyond the scope of the British Association, and should be carried

out at the national charge, being of the highest importance to the country. The determination of the number of cubic feet of water carried down at selected points on the English rivers, particularising whether it represents *dry-weather*, *average*, or *flood-flow*, would be of very high value, and might well be undertaken by the Association. Such observations, stating the run-off per square mile of drainage area and the geological character of the area drained, would have more than a *local* value. Permeable rocks below the permanent water-level of a district may be regarded as a reservoir of which the cubic content is limited by the size of the spaces between the grains, and the width of the fissures and cracks by which the rock may be traversed. The quantity of water such rocks are capable of storing has had much light thrown upon it by the investigations of Mr. Wethered, published in the fourth appendix to our eighth report.

METEORIC DUST.

The report of the committee on "Meteoric Dust" was presented by Prof. A. Schuster, who delivered a verbal address, in the course of which he said that a committee was appointed four or five years ago to see primarily whether there was any meteoric dust to be found, and, secondly, to examine it. He had only to present a few specimens of meteoric particles which had been found in the snow of the Himalaya mountains. Of these those present could judge for themselves as to the probability of their being meteoric or not. These contained a quantity of spherical particles of iron which must at one time have been in a state of fusion, so as to have taken the spherical shape or the shape of a drop. These specimens came from a height of 13,400 ft., and the nearest hut from the spot where they were found was at a distance of fourteen miles, so that they were very far removed from any place where iron was likely to be found. The whole work of the committee had been in examining these specimens.

ON THE EVILS ARISING FROM THE POLLUTION OF RIVERS.

By Gen. Sir J. E. Alexander, C.B., F.R.S.E.

The author has been for a long period a member of the Association for the preservation from pollution of the Rivers and Lochs of Scotland, and also of the Council of the Scotch Fisheries Improvement Association, and therefore takes deep interest in the above question.

One great impediment to the improvement of rivers arises from the owners of woollen and paper mills obtaining high rents from tenants who pollute the streams. The proprietor knows that if the tenant is interfered with his own income will be jeopardised, and therefore he allows the injurious pollution to continue.

The author is of opinion that members of both Houses of Parliament should take up the question of anti-pollution energetically, frame laws, and *see them put in force by the Government*, to preserve our valuable waters for the health of the people and the production of fish.

INFLUENCE OF THE SUN AND MOON ON THE LEVEL OF UNDERGROUND WATER.

On the Attractive Influence of the Sun and Moon in causing Tides, and the Variations in Atmospheric Pressure and Rainfall, causing oscillations in the underground waters in porous strata.

By Isaac Roberts, F.G.S., F.R.A.S.

The investigations have been made at Maghull, which is an agricultural district, about 8 miles to the N.E. of Liverpool, and relate to movements in the underground water of the Triassic rocks which lie beneath the surface of the ground. The water in these rocks is by capillarity, made to form an inclined plane towards the sea, which at Maghull has its surface at 60 ft. above mean sea level. The surface of the water plane was shown to be in a state exceedingly sensitive to the following influences, namely :—

Atmospheric Pressure,
Lunar Attraction,
And Solar Attraction.

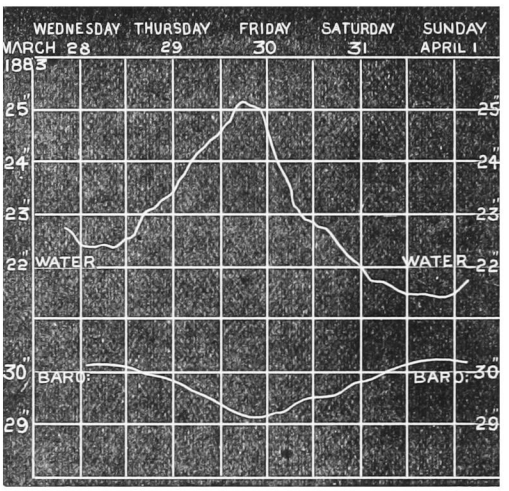
In order to determine the relative extent of these and other disturbing influences upon the water plane, an artesian well was sunk in the Triassic rocks, to a point below mean sea level, and the rise and fall of the column of water, 60 ft. in height, freed from the friction in the rock, was used as the means of registering those disturbances in the water plane, by using a mechanical contrivance of a float and drum (caused to revolve by clock-work), to trace a curve upon the diagram paper.

The curve showed the extent, from moment to moment, of the atmospheric variations, and also the effects of the attraction of the Sun and Moon upon the water plane, in producing oscillation in the first case, and true semi-diurnal lunar and solar tides in the latter case.

The effect of the rainfall was also shown on the diagram.

It was also shown that there were intervals when all the forces which have been named above were in equilibrium, the water plane remaining in a state of perfect quiscence during those periods.

The diagram shows the effects of the atmospheric disturbance which occurred between the 28th March and 1st April, 1883. The lower curve shows the variations in the barometrical pressure and the upper curve the simultaneous movements in the underground water. It will be observed on comparing the curves, that between noon and 8 o'clock on the 28th March, the underground water was nearly steady at 22·4 in., and the barometer was also nearly steady at 30·1 in. On the 30th, at 5 o'clock in the morning, the underground water had risen to 25·18 in., and at 8 o'clock the same morning, the barometer had fallen to 29·1 in., thus showing that a fall of 1 in. in the barometric pressure had affected the level of the water underground to the extent of 2·75 in. The diagram showed



many similar coincidences of this character, besides those which are traceable to rainfall, and to lunar and solar attraction.

A new field of enquiry appears to be opened out by these investigations, and the author is still steadily pursuing them, as he has done for several years past and the full result of his studies in these directions may be looked for shortly.

THE HEAT OF SUNSHINE.

On the heat of sunshine at Kew and London, as shown by Campbell's sunshine recorder.

By Professors Roscoe and Balfour Stewart.

After describing Campbell's arrangement of mahogany bowls, into which the sun burned a mark by means of a lens, the results obtained by the observations made were thus stated by the authors :—

(1). The yearly value of sunshine at Kew is greater than that at London, in the rate of 100 to 58.

(2). The half-yearly value at both places is greater for the half-year between the summer and winter solstice than for that between the winter and summer solstice, this difference being more marked for London than for Kew.

(3). As far as the authors can judge from the limited number of observations at their disposal, the heat of sunshine is greater at times of maximum than at times of minimum sun-spot frequency. At the same time there is an indication of another subsidiary maximum —this forming a double terrestrial period corresponding to a single period of sun spots.

SUN SPOT INEQUALITIES.

On sun spot irregularities of short periods.

By Prof. Balfour Stewart and W. Lant Carpenter, Esq.

The authors described a method of detecting unknown inequalities

in a mass of observations, and stated that (reserving the question of *true* or *apparent* periodicity) there were strong evidences of the existence of two separate sun-spot inequalities of periods not far different from 26 days. It was shown that each appeared as nearly as possible in the same place and with the same range for three series of twelve years each, viz., 1832-43, 1844-55, 1856-67, these embracing all the observations at the authors' disposal.

The average value of these inequalities may be represented by regarding the mean sun-spot value as 1,000, in which case this would become less than 900 at the minimum period of the inequality, and greater than 1,100 at its maximum period.

It is believed by the authors that these inequalities have definite representatives in terrestrial temperature range.

ON THE COMPLETION OF THE EUROPEAN PORTION OF THE PRELIMINARY METEOROLOGICAL CATALOGUE.

By G. J. SYMONS.

THE author commenced by giving a few illustrations of the large amount of time and energy which has been wasted by meteorologists owing to their not knowing what had previously been done, sometimes even in their own country, but most frequently in other parts of the world; and he pointed out that with the modern development of meteorological work and of meteorological literature, some effort, upon a large scale, to deal with this evil was imperatively necessary.

Mr. Symons described the catalogue which he had formed during the last 20 or 25 years, by extracting (from many thousand catalogues issued by dealers in second-hand books in most of the capitals of Europe) all the titles of works on meteorology or kindred subjects. He also described the important publication, by the Royal Society, of its *Catalogue of Scientific Papers*, and showed wherein the two agreed, and how largely each supplemented deficiencies in the other.

He then explained the steps which Prof. Cleveland Abbe had taken in preparing his card catalogue, and the arrangements whereby a copy of Mr. Symons' catalogue was to be prepared and forwarded to the United States for incorporation with Prof. Abbe's.

Mr. Symons then stated the additions which had been made to the original proposal, and that the following catalogues had been subsequently incorporated, each giving *approximately* the number of titles set against it, viz. :—

Prof. A. Poëy's	MS.	6,000
Ronald's	Printed	3,000
Struve's Pulkova	Printed	3,000
Meteorological Society	MS., and printed	2,000
Houzeau's Belgian	Printed	2,000
Soc. Météor de France	MS.	1,500
Royal Observatory, Greenwich.	MS.	500
Fineman's Swedish	Printed	500
	Total about	18,500

Of course a great many of these were duplicates, but every catalogue contained titles which were not in any of the others, and altogether they have undoubtedly added very largely to the value of the work; it is impossible to state how largely, nor is it material in a case wherein the assistance rendered has been almost as great as the catalogue, and as diverse as the languages dealt with.

The precise number of titles forwarded is not known, but is probably about 20,000. Prof. Abbe's catalogue is understood to contain about 10,000, but probably there will be a few thousand common to both catalogues, and therefore the preliminary catalogue, which the United States Signal Office, under the direction of General Hazen, will proceed to prepare for publication, will probably contain the titles of more than 25,000 books and papers upon meteorology.

Mr. Symons remarked, in conclusion, that the catalogue must not be regarded as complete. It was impossible to make it perfect—it could not be perfect as regarded the past until every public and private library in the world had been searched. It could not be perfect for the present, because every day new works appeared in different parts of the world, and all could not be simultaneously inserted. Nor would his part of it bear bibliographical criticism, for he was not a bibliographical expert, and his chief aim had been to give information useful to working meteorologists.

HOW TO KEEP THE CLOCK RIGHT.

To the Editor of the Meteorological Magazine.

SIR,—In the letter published in your September number, and headed "How to keep the clock right," from H. B. T. Strangways, Esq., and your note annexed thereto, the need of a clock capable of keeping a certain limit of rate, and produceable at, say £5, is fully expressed; but the real difficulties in the way of carrying out so desirable an end are not fully apprehended. The opinion that "very superior work in the train is not required" is certainly correct; the true performance of the clock will depend almost entirely upon the use of a weight and not a mainspring, and upon a properly proportioned and constructed pendulum; the other portions of the clock may be of a comparatively rough-and-ready kind. The difficulty of producing the clock for £5 really lies in the cost of the case; the pendulum must be a certain known length in order to beat seconds, and the weight must have a certain fall to keep the clock going eight days; if, therefore, the pendulum, and the weight during the whole length of fall, are to be enclosed in the case, it would be out of the question to produce the clock at the proposed price; but if it be acceded that the movement and dial need alone be enclosed, and the pendulum and weight left uncased in, we are quite prepared to make the clock at the proposed price of £5, and guarantee the result of a maximum error of 15 seconds a week.

In the matter of a cheap transit instrument, that just produced

under the auspices of Mr. Latimer Clark, with his very valuable tables, is just to your point, or if sun alone be taken, a Dent's dipleidoscope.—Yours truly,

JOHN ALEXANDER LUND,

Managing Director, The Standard Time and Telephone Company.
19 *and* 21, *Queen Victoria Street, E.C.*.

To the Editor of the Meteorological Magazine.

SIR,—The prominence that you have given to my last letter leads me to think that a few more remarks on clocks may not be unacceptable.

My electric clock is driven, not merely controlled, by electricity, and the action is quite independent of any variation in the current; the electricity keeps the pendulum in motion, and the clock train merely acts as a counter to record the number of the beats of the pendulum. For battery I use a modification of Cromwell Varley's gravity Daniel; the cells require attention about once a month, consuming in that period about a pound of sulphate of copper. I made this clock myself, with the exception of turning and boring the long pendulum bob, and fitting the small ratchet wheel and step by step motion to the dial works, which latter consist of a half-guinea American clock. The whole of my outlay on the clock was about £4, and there is no reason why any one who is tolerably handy with the tools should not make one for this sum, as I would readily let any one introduced by you, take the measurements of the various parts. I sent some particulars of this clock to the Astronomer Royal, who replied that the action appeared to be somewhat similar to that of the solar mean-time clock at the Greenwich Observatory.

Your old-fashioned eight day clock is not an answer to my statement, that "to keep accurate time, not only must the pendulum be accurately compensated, but the work done by the pendulum and the impulse received by it must be constant and equal on both sides." No doubt the accuracy of a clock depends chiefly on the pendulum, but the most accurately compensated pendulum cannot keep time if driven by a jerky train. The old eight-day clocks were generally very well made; in many of them the work was as good as that put into a considerable proportion of the modern "regulators;" therefore I am not at all surprised at the good performance of your clock; but you cannot buy such a clock new for £3 10s., the case alone would cost nearly double the money; and when these old clocks get into the hands of London men, they break them up. I have seen nearly half a cart-load in a clockmaker's loft in Clerkenwell. Some time ago, Horne and Thornethwaite, the opticians, tried to bring out a reliable clock at a moderate price, but they could not do it at a very low price, and the few who would pay the sum they had to charge were generally able to pay the further amount necessary to obtain a first-class clock. I do not know where such a clock as you require can be got new for £5; the nearest approach is the Vienna Regulator, beating seconds, and which can be seen at nearly all the co-operative

stores. If any one should offer to supply for £5 such a clock as you seek, I advise your readers to order one at once, as I am sure the supply will not continue long, or the quality will fall off, unless the maker is unusually patriotic and superior to all considerations of £. s. d.

A transit instrument, sufficient for your stated requirements, ought to be supplied for £5, if twenty or more were ordered; at present the nearest approach will be found in Dent's dipleidoscope.

I remain, your obedient servant,

H. B. T. STRANGWAYS.

5, *Pump Court, Temple, E.C., Oct. 2nd*, 1883.

[Although each of our correspondents object to some of our conditions, we consider that our aim has been reached. For Mr. Lund's only difficulty is in the case, and the case is not the clock, and its pattern and material may well be left to the option of purchasers. We believe that a neat case could be made of seasoned stained pine, 1 in. thick, and about 6ft. by 1ft. 6in. by 9in., with hinges and lock, for £2; and recommend their general adoption. It would probably strengthen Mr. Lund's position, and certainly tend to the general good, if some of our readers would order them at once, and think that they will not only be doing wisely from a scientific point of view, but also from a commercial one.

We yield to no one in our admiration of Mr. Latimer Clark's transit instrument, but we think that something rather lower in price is desirable.

We only recorded the performance of our clock in support of our opinion that "very superior work in the train is not required;" it is just such a clock as Mr. Strangways says the London men break up, and yet the results were what we gave. However, as Mr. Lund says that our opinion was correct, we are content there to leave that matter.—ED.]

SOLAR HALOES.

To the Editor of the Meteorological Magazine.

SIR,—Yesterday afternoon I saw a fine display of solar halos on a sheet of cirro-stratus travelling from N.N.W. from 4.10 to 4.30 p.m.; of which I append a sketch made at 4.15 p.m.

The small halo, A, was $22\frac{1}{2}°$ in its semi-diameter, the large one, B, 45°. The prismatic colours were bright, especially those of the intersecting arcs C and D, which had the green inside, reversing the order in the rings A and B.

The smaller halo disappeared at 4.17 p.m., but the highest arc, D, was very bright from 4.25 to 4.30 p.m., when the whole display was covered by intervening clouds. At 4.10 p.m. (3rd) the barometer (reduced to 32° and sea level) read 30·094 in., the dry bulb ther-

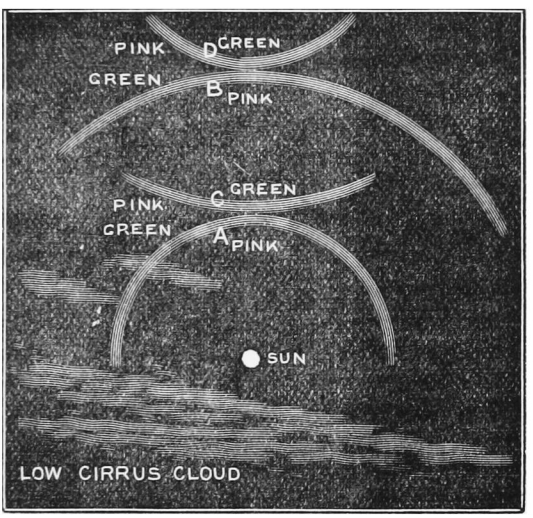
mometer 52°·7, wet bulb 48°·8, and the wind was N.N.W., force 2. The barometer has fallen rapidly since yesterday, the wind has backed to W.S.W. and blows strongly, and ·02 in. of rain fell last night,

Yours sincerely,

EDWIN E. GLYDE.

Kirkham, Babbacombe, Torquay, Oct. 3rd, 1883.

P.S.—Heavy rain has fallen since noon, amounting at 3 p.m. to 0·35 in., and it is now, 3.30 p.m., raining again, with a very cold wind. H fell at 0.33 p.m.



A CAPE HAILSTORM.

An extraordinary violent hailstorm is reported from Graaf-Reinet, where the hailstones are said to have been as "large as oranges," and to have lain "some inches deep." Besides breaking windows and beating down the crops and doing other damage generally expected of heavy hailstorms, this particular visitation is said to have broken down the branches of large trees, killed several ostriches, smashed the roofs of several sheds, and knocked down two or three men. On one farm at Galgenbosch it is said that thirty ostriches were killed outright, and many others injured. It would be interesting to know if the locality in question is subject to heavy hailstorms, and, if so, whether the forests have lately been cut down in the neighbourhood; for the experience of *savans* in Switzerland is that hailstorms are most severe where forest denudation has been most complete.—*Colonies, July 6th.*

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, APRIL, 1883.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	Total Rain. Depth.	Total Rain. Days.	Aver. Cloud.
	°		°		°	°	°	0–100	°	°	inches		
England, London	68·9	5	29·3	9	58·7	38·9	38·1	70	94·2	35·7	1·56	9	5·9
Cape of Good Hope	...	...	...	...	...	...	...	...	...	...	...	...	...
Mauritius	83·7	3	66·1	20	81·1	72·1	69·5	80	...	...	12·22	19	5·9
Calcutta	99·5	9	69·5	28	93·8	75·0	73·8	74	154·8	62·3	2·96	7	3·1
Madras	...	...	...	...	...	...	...	...	...	...	...	...	...
Bombay	92·5	17	72·8	5	88·5	77·6	74·8	76	144·5	64·2	·00	0	1·5
Ceylon, Colombo	92·0	4	72·8	7	89·1	76·4	72·7	72	155·7	68·0	8·83	17	6·1
Melbourne	84·7	2	45·2	26	71·5	51·7	49·6	68	141·6	39·3	·95	6	5·6
Adelaide	93·3	1	48·4	23	74·9	55·6	48·5	54	155·0	38·9	2·53	11	4·7
Wellington	69·8	14	41·0	25	60·5	49·2	...	...	133·0	39·0	4·32	18	...
Auckland	71·5	9	45·0	18	66·5	53·6	53·4	79	131·8	...	9·94	23	6·9
Falkland Isles	56·7	10	24·3	18	47·5	36·3	40·5	91	119·0	26·2	3·30	23	8·0
Jamaica, Kingston	88·8	7	66·8	17	85·4	70·5	69·5	75	...	60·4	·28	4	3·9
Barbados	82·0	24	69·0	var.	80·0	71·0	70·3	77	149·0	66·0	2·55	15	6·0
Toronto	64·6	15	11·9	2	46·8	29·6	30·6	69	122·5	5·0	2·54	9	6·5
New Brunswick, S. John	49·0	18	15·0	1	42·0	29·3	31·7	83	...	...	1·84	10	5·8
Manitoba, Winnipeg	62·8	26	—3·2	1	43·1	23·5	27·8	76	128·0	...	·76	9	4·8
British Columbia, Yale	75·5	26	19·4	14	56·7	29·9	...	...	...	...	·45	11	5·5

REMARKS, APRIL, 1883.

Mauritius.—Rainfall 6·12 in. above the average; mean temp. 0°·5 below it; mean pressure 30·010 in.; mean hourly velocity of wind 9·9 miles, extremes 25 miles and 2·4 miles; prevailing direction E.S.E. to E. by N.; T and L on 11 days; floods on 17th to 19th. C. MELDRUM, F.R.S.

CEYLON.—TSS occurred on every day except the 10th and 11th.

Melbourne.—Mean temp. of air above the average; mean pressure, temp. of dew-point and humidity about the average; amount of cloud and total R both below it; prevailing direction of wind N.E. and N., strong breezes occurring on 7 days; heavy dew on 11 days, fog on 25th, lunar halos on 15th and 20th. R. L. J. ELLERY, F.R.S.

Adelaide.—Mean pressure (30·168 in.) about the average of 26 years; mean temp. slightly above the average, though the ther. only once registered 90°. Rainfall nearly 1 in. above the average, but very unevenly distributed, nearly 2 in. falling on 2nd, while after the 10th scarcely any fell; from 8th to end of the month the bar. did not once fall below 30 in. C. TODD.

Wellington.—Generally unpleasant, squally, and showery till the 18th; stormy on several days; from 19th to 27th fine, though dull at times, with light winds, chiefly easterly; last three days showery; fog on 27th and 28th; Mean temp. 2°·3 below the average R. B. GORE.

Auckland.—Rainfall excessive, more than three times the average, and falling on twice the average number of days; 2·33 in. fell each day on 10th and 11th; mean temp. 2°·3 below the average; mean pressure (30·078 in.) almost identical with the average; T on 15th and 16th. E. B. DICKSON.

BARBADOS.—Mean temp. (74°·8) 0°·8 above the average of 25 years; prevailing direction of wind N.E.; rainfall 4 per cent. above the average; evaporation 11 per cent. above it; slight shock of earthquake on 2nd. R. BOWIE WALCOTT.

SUPPLEMENTARY TABLE OF RAINFALL, SEPTEMBER, 1883.

[For the Counties, Latitudes, and Longitudes of most of these Stations, see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	3·69	XI.	Llanfrechfa Grange	7·09
,,	Margate, Birchington...	3·11	,,	Llandovery	4·71
,,	Littlehampton	4·89	,,	Solva	4·99
,,	St. Leonards	3·84	,,	Castle Malgwyn	4·70
,,	Hailsham	...	,,	Rhayader, Nantgwillt..	8·73
,,	I. of W., St. Lawrence.	4·36	,,	Carno, Tybrith	8·54
,,	Alton, Ashdell.....	4·23	,,	Corwen, Rhug	...
III.	Winslow, Addington ...	4·74	,,	Port Madoc	6·03
,,	Oxford, Magdalen Col...	4·50	,,	I. of Man, Douglas	9·21
,,	Northampton	4·66	XII.	Carsphairn	...
,,	Cambridge, Beech Ho...	4·38	,,	Melrose, Abbey Gate...	4·64
IV.	Southend	...	XIII.	N. Esk Res. [Penicuick]	3·50
,,	Harlow, Sheering	2·92	XIV.	Ayr, Cassillis House ..	3·65
,,	Diss	3·66	,,	Glasgow, Queen's Park..	3·47
,,	Swaffham	5·84	XV.	Islay, Gruinart School..	3·20
,,	Hindringham	6·27	XVI.	St.Andrews,NewtonBk	3·30
V.	Salisbury, Alderbury...	3·76	,,	Aberfeldy H.R.S.	1·28
,,	Warminster	4·17	,,	Dalnaspidal H.R.S. ...	5·09
,,	Calne, Compton Bassett	3·98	XVII.	Keith H.R.S.	5·62
,,	Beaminster Vicarage ...	7·50	XVIII.	Forres H.R.S.	2·78
,,	Ashburton, Holne Vic..	10·06	,,	Strome Ferry H.R.S....	3·26
,,	Torrington, Langtree W.	...	,,	Lochbroom	3·94
,,	Lynmouth, Glenthorne.	5·59	,,	Tain, Springfield.....	2·90
,,	Probus, Lamellyn	5·95	,,	Loch Shiel, Glenaladale	6 37
,,	Taunton, Fullands	3·52	XIX.	Lairg H.R.S.	3·10
VI.	Bristol, Clifton	4·48	,,	Forsinard H.R.S.	3·47
,,	Ross	4·52	,,	Watten H.R.S.	4·04
,,	Wem, Sansaw Hall.....	5·45	XX.	Fermoy, Glenville	6·37
,,	Cheadle, The Heath Ho.	6·56	,,	Tralee, Castlemorris ...	3·60
,,	Worcester, Diglis Lock	4·56	,,	Tipperary, Henry Street	5·36
,,	Coventry, Coundon	5·41	,,	Newcastle West	4·07
VII.	Melton, Coston	5·46	,,	Kilrush	...
,,	Ketton Hall [Stamford]	5·90	,,	Corofin	3·40
,,	Horncastle, Bucknall ...	5·34	XXI.	Carlow, Browne's Hill..	4·53
,,	Mansfield, St. John's St.	5·76	,,	Navan, Balrath	2·00
VIII.	Macclesfield, The Park.	5·64	,,	Athlone, Twyford	4·09
,,	Walton-on-the-Hill.....	5·39	XXII.	Mullingar, Belvedere ...	4·29
,,	Lancaster, South Road.	4·90	,,	Clifden, Kylemore	...
,,	Broughton-in-Furness ..	6·44	,,	Crossmolina, Enniscoe..	4·90
IX.	Wakefield, Stanley Vic.	4·80	,,	Carrick-on-Shannon ...	4·45
,,	Ripon, Mickley	4·61	XXIII.	Dowra	...
,,	Scarborough.....	3·97	,,	Rockcorry.....	3·74
,,	EastLayton[Darlington]	3·82	,,	Warrenpoint	5·14
,,	Middleton, Mickleton ..	4·88	,,	Newtownards	3·73
X.	Haltwhistle, Unthank..	5·46	,,	Belfast, New Barnsley..	5·80
,,	Shap, Copy Hill	4·74	,,	Bushmills	5·98
			,,	Buncrana	5·19

SEPTEMBER, 1883.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1870–9	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32° In shade.	On grass.
			inches	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	3·83	+ 1·33	·65	29	18	75·3	18	41·4	23	0	0
II.		Maidstone (Hunton Court)...	3·42	+ 1·11	·53	20	17	...	...	...	...	..	...
,,		Strathfield Turgiss	3·09	+ ·79	·65	29	14	72·8	18	36·4	9	0	1
III.		Hitchin	3·52	+ 1·04	·71	29	17	67·0	19	39·0	22	0	...
,,		Banbury	4·21	+ 1·40	1·04	29	18	72·0	18	37·0	9	0	...
IV.		Bury St. Edmunds (Culford)	4·24	+ 1·46	·73	30	17	70·0	12*a*	36·0	5	0	..
,,		Norwich (Cossey)	3·37	+ ·29	·55	29	18	74·5	17	42·5	30	0	...
V.		Bridport	6·12	...	1·23	23	19	...	..	...	...	...	...
,,		Barnstaple.....	5·19	+ ·91	·80	28	17	74·0	18	36·5	14	0	..
,,		Bodmin	7·04	+ 1·80	1·75	23	21	74·0	18	42·0	9	0	1
VI.		Cirencester	4·43	+ 1·29	·89	10	19	..	...	...	...	...	...
,,		ChurchStretton(Woolstaston)	5·48	+ 2·01	1·15	2	21	71·0	17	44·5	29	0	0
,,		Tenbury (Orleton)	5·14	+ 1·79	·94	10	19	73·0	18	35·2	9	0	0
VII.		Leicester	5·12	...	·94	2	21	77·2	18	40·8	9	0	0
,,		Boston	6·75	+ 4·14	3·10	29	15	72·0	18	41·0	9	0	...
,,		Grimsby (Killingholme).....	4·21	+ 1·14	·88	10	22	69·0	19	42·5	9	0	...
,,		Hesley Hall [Tickhill].....	6·55	...	1·16	10	20	75·0	17*b*	40·0	9, 13	0	...
VIII.		Manchester (Ardwick).....	5·37	+ 1·60	81·	28	20	74·0	18	45·0	9	0	...
IX.		Wetherby (Ribston Hall) ...	4·71	+ 1·63	·72	11	14	...	...	...	...	...	...
,,		Skipton (Arncliffe)	6·72	+ 1·14	·63	24	23	71·0	17	37·0	8	0	...
X.		North Shields	3·09	+ ·77	·66	20	21	68·2	11*c*	40·8	6, 23	0	0
,,		Borrowdale (Seathwaite).....	13·37	+ ·15	3·30	26	21	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	6·80	+ 2·00	1·62	23	20	...	...	...	...	...	...
,,		Haverfordwest	7·16	+ 2·11	2·00	1	19	67·8	15	39·4	5	0	...
,,		Plinlimmon (Cwmsymlog) ...	8·21	...	1·30	26	18	...	...	...	...	...	...
,,		Llandudno.....	3·38	— ·37	·59	20	19	68·6	19	46·0	6	0	0
XII.	SCOTLAND.	Cargen [Dumfries]	4·03	— ·38	1·14	26	16	69·8	18	36·6	12	0	...
,,		Hawick	3·52	+ ·88	·72	20	15	...	...	..	...	...	...
XIV.		Douglas Castle (Newmains)	4·46	+ ·06	·87	26	18	...	...	...	...	...	...
XV.		Lochgilphead (Kilmory).....	2·54	— 3·22	·57	6	15	...	...	...	...	...	...
,,		Appin (Airds)	3·24	...	...	...	...	...	...	...	...	...	...
,,		Mull (Quinish).....	2·85	...	·38	6,25	18	...	...	...	...	...	.
XVI.		Loch Leven Sluices	3·20	— ·03	1·00	2	12	...	...	...	...	...	...
,,		Arbroath	1·74	— 1·33	·52	26	14	65·0	16	38·0	12	0	...
XVII.		Braemar	4·64	+ ·70	1·35	2	18	65·7	17	30·3	12	1	8
,,		Aberdeen	3·33	...	·80	2	23	65·0	25	33·0	21	0	0
XVIII		Skye (Sligachan)	...	...	...	...	...	...	...	...	...	...	...
,,		Culloden	3·27	+ ·37	·98	1	14	70·0	3	36·0	21	0	2
XIX.		Dunrobin	2·86	...	·82	2	15	62·5	8	37·5	23	0	...
,,		Orkney (Sandwick)..... ..	3·67	+ ·18	1·07	4	17	62·0	16	40·4	23	0	1
XX.	IRELAND.	Cork (Blackrock)	6·17	+ 2·02	2·98	1	14	78·0	22	43·0	30	0	0
,,		Dromore Castle	7·21	...	2·18	1	21	65·0	16	42·0	4, 10	0	...
,,		Waterford (Brook Lodge) ...	4·75	...	1·75	1	18	70·0	15	38·5	12	0	...
,,		Killaloe	4·41	...	·81	1	16	74·0	16	44·0	16	0	...
XXI.		Portarlington	3·41	+ ·23	·84	1	16	67·0	14	42·0	10	0	...
,,		Dublin (FitzWilliam Square)	3·64	+ 1·23	1·38	1	14	66·7	24	41·2	12	0	0
XXII.		Ballinasloe	4·29	+ ·33	1·07	1	16	64·0	13	40·0	11	0	...
XXIII.		Waringstown	4·10	+ ·75	1·12	28	16	74·0	18	38·0	12	0	1
,,		Londonderry (Creggan Res.).	5·04	...	·79	20	21	...	...	...	...	...	...
,,		Omagh (Edenfel)	4·44	+ ·40	·68	20	19	70·0	17	39·0	30	0	...

+ Shows that the fall was above the average; — that it was below it.

a And 14, 18, 9. *b* And 18. *c* And 27.

METEOROLOGICAL NOTES ON SEPTEMBER.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain H for Hail S for Snow.

ENGLAND.

STRATHFIELD TURGISS.—The harvest was gathered in in excellent condition, and the potato crop is said to be the best on record, the yield being extraordinarily good.

BANBURY.—The month was not altogether unfavourable for harvest work, as the R was generally followed by drying wind, and most of the corn has been saved. Mean temp. 55°·0. A TS occurred on 20th, during which an instance of ball lightning was observed by Mr. C. Fortescue and his little boy; it moved slowly among the clouds, going horizontally, and then shooting upwards; it did not appear to strike the earth. The storm was very severe a few miles S. of this station, but not so here; high wind on six days; several fogs.

CULFORD.—The month commenced with cold winds and R, followed by bright and sunny days, favourable for the ingathering of the potato and apple crops; very high wind on 3rd.

CIRENCESTER.—Not a good month for the harvest, and consequently a little corn was injured in backward districts.

WOOLSTASTON.—A warm and pleasant month. Harvest secured in fairly good condition, notwithstanding a considerable amount of R; much damage was, however, done to standing crops by the tremendous gale which commenced on the evening of the 1st, and continued during the night and following morning; severe gales occurred also on the nights of the 23rd and 25th; mean temp. of the month, 55°·4.

ORLETON.—The first ten days were cold and stormy, with heavy falls of R; an interval then occurred of nine days, with much sunshine and temp. above the average; the remainder of the month was generally cloudy, cold, and stormy, with much R; mean temp. of the month more than 1° below the average of 22 years; L and T on 20th; great gales on 2nd and 26th. Much of the spring-planted wheat out in the fields at the end of the month, and some not cut.

KILLINGHOLME.—Weather very unsettled with much R, but a few fine days with brisk winds allowed a good deal of corn to be carried in fair condition.

MANCHESTER.—As a whole the month was wet, especially in the earlier and latter portions; the weather cleared up for several days towards the middle, which was an especial boon to farmers, but the heavy rainfall has been injurious to the cereal crops, though favourable for the green crops.

WALES.

HAVERFORDWEST.—On the last day of August the sky presented a very threatening appearance, large masses of cumuli congregated in the N.W., forming a grand curtain of storm cloud of gorgeous colours at sunset, violent motion being observable in the mass; an opposite current of cloud was advancing rapidly from the S.S.E., and R fell to the amount of ·10 in. in about half an hour before 9 p.m. The morning of the 1st broke stormily, with heavy rainfall, increasing to a heavy gale; the bar. fell from 29·396 in. (corr. and red.) at 9 a.m. to 28·655 in. at 9 p.m., and to 28·410 in. at 3 a.m. on the 2nd, the whole of that day being exceedingly wild and stormy. Although there were a large number of fine days, the rainfall of the month was excessive, but the mean temp. was high, and excellent crops were well harvested.

LLANDUDNO.—Mean temp. slightly below the average; humidity and number of rainy days considerably above the average, but there was a fine spell of dry bright weather from the 11th to 18th inclusive. On 20th it rained persistently, and more or less R fell almost daily till the end of the month. The temp. was very steady throughout; and the range, both diurnal and monthly,

was moderate, and considerably below the average. There was a short but very violent gale on 26th from S.W.; gales from N. and N.E. occurred also on 29th and 30th. There were 121 hours of bright sunshine.

SCOTLAND.

CARGEN.—Mean temp. 54°·2, being 0°·7 below the average; very stormy and wet weather during the latter half of the month; little grain got in, and cut crops much damaged; T and L on 3rd and 18th. T on 1st.

HAWICK.—The middle of the month was mild and favourable for harvest work, but the last nine days were cold and wet; very stormy on the 25th, causing a high flood on the Teviot. Potato disease showed itself towards the close of the month, and the heavy rains of the last days caused it to spread. No frosts occurred, and all tender annuals of the flower garden were blooming beautifully at the end of the month; hurricane on 25th.

ABERDEEN.—Although the general character of the weather was rainy and unsettled, the total rainfall does not exceed the average; L on 1st; brilliant aurora on 5th.

CULLODEN.—The month generally was cold, and, R falling on many days, caused a long-continued ingathering of the crops.

SANDWICK.—A cold month, owing to the prevalence of N. winds, particularly on the first five and last five days; the first week was also very wet, 1·07 in. falling on 4th; the harvest being late, it was well that no equinoctial gale occurred to injure the crop.

IRELAND.

BLACKROCK.—Temp. below the average, but many dry days occurred, favourable for harvest; very heavy R on 1st, after 14 days of dry weather.

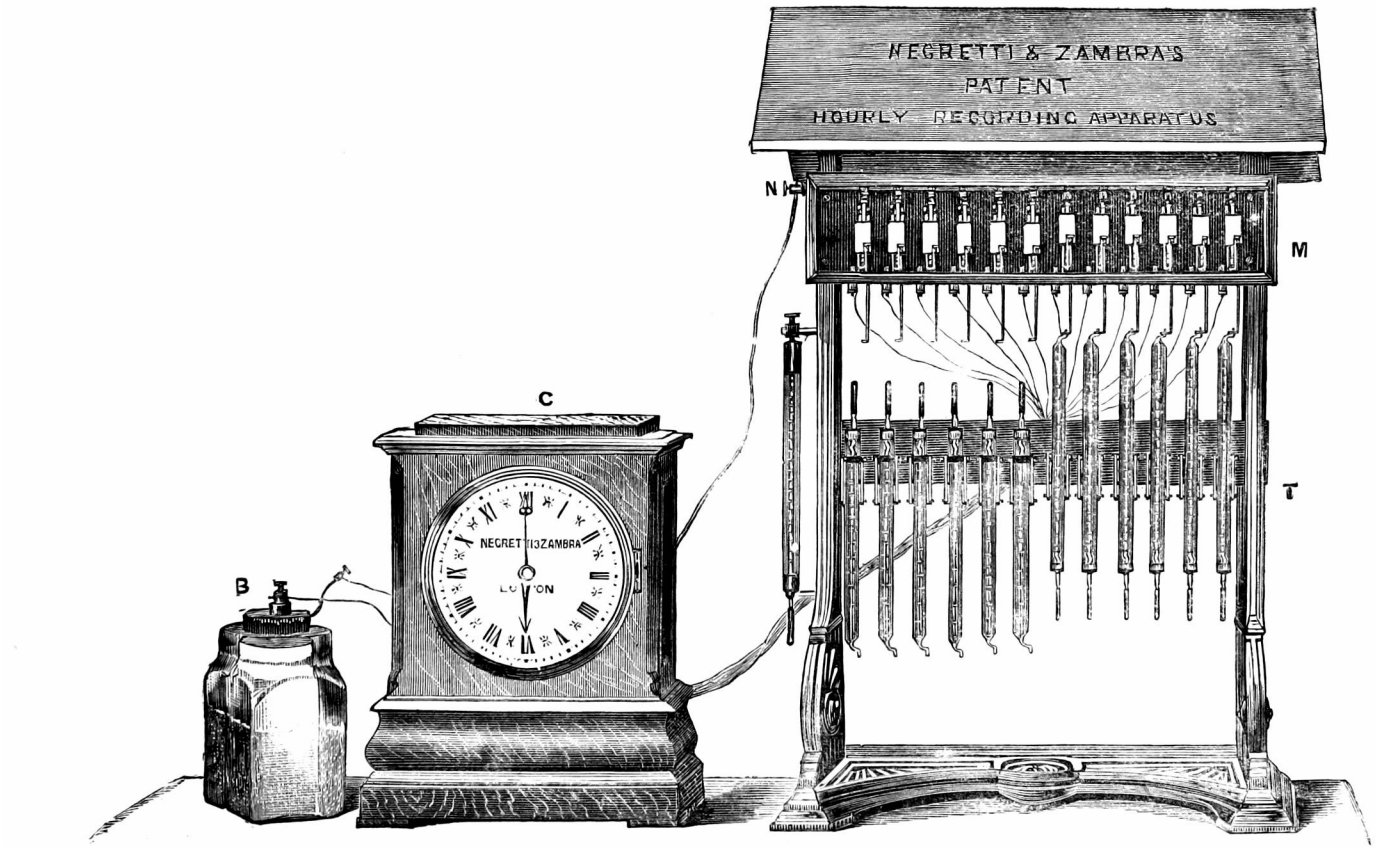
DROMORE CASTLE.—A very disastrous month for the crops; the violent gale of the 23rd levelled corn stooks and haycocks, and a succeeding week of R did not allow them to be made up dry. Temp. high all the month; potato crop in most places still very good.

WATERFORD.—Gales from S.E. on 1st with heavy R, and on 25th from W.S.W. Rainfall about half an inch above the average.

KILLALOE.—A very violent storm prevailed for about two hours on the morning of the 26th: trees were uprooted in great numbers, and corn and hay in stack and shocks were blown down, and scattered about; heavy R succeeded, which seriously injured the unhoused crops. The month closed with strong and steady N. winds, of great benefit to farmers who had suffered from the storm and R.

DUBLIN, FITZWILLIAM SQUARE.—Although rough and unsettled at the beginning and close, this was in general a favourable month—a period of quiet, fine weather lasting from the 9th to 19th inclusive. Mean temp. (54°·7) slightly below the average; of the total rainfall more than one-third fell on the 1st. Very violent storms occurred on the 1st and 26th, and the wind blew strongly on many days both at the commencement and towards the end of the month; solar halo on 18th; aurora on 5th; fog on the 13th to 16th and on 20th.

EDENFEL.—The first and last weeks of the month were stormy and wet, the remaining fortnight being the finest weather of the year; harvest abundant, but not more than half cut, and none carried, at the close of the month; on 15th, ·58 in. of R fell in less than an hour.



NEGRETTI & ZAMBRA'S PATENT HOURLY RECORDING THERMOMETRICAL APPARATUS.—*See page* 150.